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Federal Security Laboratory Governance Panels: Observations and Recommendations

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Susannah V. Howieson
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Executive Summary

Academic institutions, nonprofit corporations, industrial firms, and Federal laboratories make up the system of research organizations that support science and technology for U.S. national security. Within this system, the Departments of Defense, Energy, and Homeland Security support about 80 laboratories that focus predominantly on national security matters. These laboratories have different missions, research portfolios, budgets, and communities of sponsors and users. They also embody a mix of governance types, including the following:

- Government-Owned/Government-Operated (GOGO) laboratories, which are run by government employees and operate under varying organizational, administrative, and research arrangements established by parent agencies
- Federally Funded Research and Development Centers (FFRDCs), which are run by private-sector organizations and maintain close, long-term relationships with government sponsors, within a structured regulatory environment
- University Affiliated Research Centers (UARCs), which are run by universities and share some but not all of the attributes and regulatory environment of FFRDCs.

For the purposes of this report, these institutions are referred to collectively as “Federal security laboratories.”

The Office of Science and Technology Policy asked the IDA Science and Technology Policy Institute (STPI) to study the relationship between Federal security laboratory governance structures and laboratory operations and performance. STPI’s research team convened expert panels composed of former and current Federal security laboratory directors; department and agency headquarters personnel; and laboratory leaders from other Federal laboratories, academia, and industry. To ensure inclusion of multiple viewpoints, the team also held discussions with individuals and groups unable to attend the panel meetings. These expert contributors are referred to collectively hereafter as “panelists.”

The discussions with panelists covered the primary trends affecting Federal security laboratories, the appropriate balance of national security work across different types of laboratories, and several personnel-related issues. Panelists also discussed the roles of Federal security laboratories in the broader U.S. national security research and development (R&D) enterprise, the characteristics of successful laboratories, and

advantages and disadvantages of various governance structures. Finally, the panelists addressed how to prepare for the future, the implications of transitioning to other governance structures, and methods for instituting best practices.

Panelists identified four trends affecting Federal security laboratories: (1) issues related to personnel, (2) competition from foreign R&D entities, (3) changes to research focus and funding at some laboratories, and (4) increased regulatory requirements and oversight.

Panelists reached four conclusions related to laboratory roles and governance: (1) Federal security laboratories fulfill a unique role in U.S. national security R&D, (2) each governance model has certain advantages, (3) critical laboratory characteristics do not necessarily depend on governance structure, and (4) both exemplar and sub-standard examples of laboratories exist under each governance model.

Panelists observed that wholesale transition of all Federal laboratories from one governance structure to another is neither advisable nor warranted, but that some of the best attributes of each governance structure could be incorporated in others. Thus, panelists recommended practices to facilitate the expanded use of the best laboratory attributes at all Federal security laboratories.

Three primary recommendations emerged from the discussions with panelists: (1) rationalize the oversight burden on the laboratories, (2) maintain or reinstitute laboratory flexibility for research budgeting, and (3) increase or maintain autonomy and accountability in personnel systems (particularly in GOGO laboratories).

Similar recommendations can be found in other reports produced in the past two decades, though panelists noted that few implementation actions have been taken to date. To the extent that new analytic evidence could help motivate change and inform choices among alternative policies, the main report notes several areas where quantitative analyses might improve understanding of the complex issues panelists raised, thus potentially strengthening the rationale for implementation actions.

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A. Introduction

The U.S. system of research organizations that supports science and technology for national security includes academic institutions, nonprofit corporations, industrial firms, and Federal laboratories. Approximately 80 laboratories in this system have a national security focus and are funded primarily by the Department of Defense (DOD), the Department of Energy (DOE), and the Department of Homeland Security (DHS). Throughout this report, these laboratories are referred to collectively as “Federal security laboratories,” regardless of governance structure and funding agency.¹

The White House Office of Science and Technology Policy (OSTP) asked the IDA Science and Technology Policy Institute (STPI) to study the relationship between Federal security laboratory governance structures and laboratory operations and outcomes. The focus of the work was on governance of three types: Government-Owned/Government-Operated (GOGO) laboratories, Federally Funded Research and Development Centers (FFRDCs), and University Affiliated Research Centers (UARCs).

The STPI study team convened expert panels composed of former and current Federal security laboratory directors; department and agency headquarters personnel; and laboratory leaders from other Federal laboratories, academia, and industry. In addition, the STPI team conducted a literature review. This report presents the findings and recommendations that emerged from the discussions with panelists and the literature review.

1. Background

The missions, research portfolios, budgets, sponsor and user communities, governance structures, agency and sub-agency cultures, and use of in-house versus outsourced researchers vary among the Federal security laboratories. For example, the Air Force Research Laboratory (AFRL) is a GOGO laboratory with multiple sites formed in 1997 through the consolidation of four former Air Force laboratories and the Air Force Office of Scientific Research. AFRL employs approximately 10,000 people and has a science and technology budget of about \$4.6 billion. Researchers at AFRL’s 10 major sites broadly focus on space vehicles, information, aerospace systems, directed energy, materials and manufacturing, sensors, and munitions. In contrast, the DHS established the National Biodefense Analysis and Countermeasures Center (NBACC) as an FFRDC managed by a subsidiary of Battelle Memorial Institute in 2002. NBACC’s 150 researchers are more narrowly focused on biological threats with a budget of about \$20 million. Table 1 provides

¹ DOE laboratories are generally known as “national laboratories,” DOD laboratories are generally known as “defense laboratories” or “service laboratories,” and National Nuclear Security Administration laboratories are generally known as “national security laboratories.” Therefore, the broader term “Federal security laboratories” is used in this report to encompass all the agencies’ laboratories with a national security mission.

characteristics of a cross-section of Federal security laboratories with structures of the three types studied.

In addition to Federal security laboratories, the national security science and technology enterprise involves defense industry organizations, universities, nonprofit corporations, small businesses, other Federal organizations, and foreign partners. By focusing exclusively on Federal security laboratories, this study touches on just one piece of the puzzle, albeit a critical one.

2. Governance Structures

Over half of the approximately 80 major Federal security laboratories are GOGO. The Naval Research Laboratory is the oldest GOGO among current military department laboratories. One of the primary differences between GOGO and other governance structures is that GOGO laboratories must comply with Federal personnel hiring practices. Because most GOGO researchers are Federal Government employees, they are subject to more constraints and restrictions than their non-GOGO counterparts. Certain employees at Federal laboratories have flexibility in compensation by virtue of being dual appointees (university and GOGO organization), and there are various experimental programs providing some Federal laboratories with special hiring and compensation authorities.²

FFRDCs are independent, private-sector organizations sponsored and funded by the Federal Government to meet special, long-term research or development needs that cannot be met as effectively by existing government or contractor resources. Parent organizations that run FFRDCs may be individual universities, university consortia, nonprofit corporations, industrial firms, or hybrid organizations.

The FFRDC concept grew out of World War II experiences, where private-sector scientific, engineering, and analytic talent was brought to bear to an unprecedented extent—and in new organizational ways—in support of U.S. wartime efforts. After the War, the Federal Government sought to retain close ties to the nation's technical expertise. Over several decades, the FFRDC concept was refined to meet continuing government needs in evolving security and regulatory environments. Today, the key characteristics of FFRDCs are broadly defined in Federal Acquisition Regulation provisions, though sponsoring agencies vary somewhat in the specific governance mechanisms and policies applied to their FFRDCs. See, for example, DOD (2011).

² For example, the National Defense Authorization Act for Fiscal Year 1995 (Pub. Law 103-337) allowed the Secretary of Defense to carry out personnel demonstration projects at the Science and Technology Reinvention Laboratories.

Table 1. Characteristics of Selected Federal Security Laboratories

Laboratory	Abbreviation	Agency	Subagency/ Managing Contractor	Governance Structure	Budget* (FY 2012)	Science and Technology Areas	Size* (FTE)	Year Est.
Air Force Research Laboratory	AFRL	DOD	Air Force	GOGO	\$4.6 B†	Space Vehicles, Information, Aerospace Systems, Directed Energy, Materials and Manufacturing, Sensors, Munitions	10,000	1997
Army Medical Research Institute for Infectious Diseases	AMRIID	DOD	Army	GOGO	\$88.9 M	Medical Product Development (biological threats), Rapid Identification of Biological Agents	750	1969
Army Research Laboratory	ARL	DOD	Army	GOGO	\$1.7 B†‡	Extramural Basic Research, Human Dimension, Lethality, Mobility and Logistics, Networks, Power and Energy, Protection, Sensors, Simulation and Training Technology, Survivability/Lethality Analysis	1,900	1992
Johns Hopkins University Applied Physics Laboratory	JHU-APL	DOD	Navy/Johns Hopkins University	UARC	\$1.1 B†	Air and Missile Defense, Civil Space, Cyber Operations, Homeland Protection, National Security Analysis, National Security Space, Precision Engagement, Research and Exploratory Development, Special Operations, Strategic Systems, Undersea Warfare	4,700	1942
Lawrence Livermore National Laboratory	LLNL	DOE	National Nuclear Security Admin./Lawrence Livermore National Security, LLC	FFRDC	\$1.6 B§	Chemistry, Materials, & Life Science; Computation; Defense & Nuclear Technologies; Energy & Environment; Engineering; National Ignition Facility; Nonproliferation, Homeland and International Security, Safety & Environmental Protection	6,800	1952
Los Alamos National Laboratory	LANL	DOE	National Nuclear Security Admin./ Los Alamos National Security, LLC	FFRDC	\$2.2 B§	Chemistry, Life and Earth Sciences; Engineering and Engineering Sciences; Experimental Physical Sciences; Information Technology; Theory, Simulation, and Computation; Plutonium Science and Manufacturing; Weapons Engineering and Experiments; Weapons Physics; Threat Identification and Response	10,700	1943
Massachusetts Institute of Technology Lincoln Laboratory	MIT-LL	DOD	Air Force/Massachusetts Institute of Technology	FFRDC	\$870 M†	Space Control, Air and Missile Defense Technology, Communications Systems and Cyber Security, ISR Systems and Technology, Advanced Technology, Tactical Systems, Homeland Protection, Air Traffic Control, Engineering	3,700	1951
National Biodefense Analysis and Countermeasure Center	NBACC	DHS	Science and Technology Directorate/Battelle National Biodefense Institute, LLC	FFRDC	\$19.9 M	Law Enforcement, Agricultural Security, Bioforensics Operations, Biological Threat Characterization, Biosecurity, Knowledge Management and Dissemination, Sensors and Signatures, Surveillance and Response, Systems Engineering and Analysis	150	2002
Naval Research Laboratory	NRL	DOD	Navy	GOGO	\$1.9 B†	Radar, Information Technology, Optical Sciences, Tactical Electronic Warfare, Chemistry, Material Science and Technology, Laboratory for Computational Physics and Fluid Dynamics, Plasma Physics, Electronics Science and Technology, Biomolecular Science and Engineering, Acoustics Division, Remote Sensing, Oceanography, Marine Geosciences, Marine Meteorology, Space Science and Technology, Space Systems Development, Spacecraft Engineering	2,700	1923
Sandia National Laboratories	Sandia	DOE	National Nuclear Security Admin./ Sandia Corporation	FFRDC	\$2.4 B§	Hydrogen, Information Technology, Intelligence Technologies and Assessments, Intelligent Systems, International Cooperation, Laser Optical Sensing, Advanced Computing	8,700	1949

* Budget and size figures are approximate. FTE means full-time equivalent.

† Budget figures for AFRL, ARL, and NRL include in-house and external funding for science and technology (S&T) (6.1-6.3); research, development, test, and evaluation (RDT&E) (6.4-6.7); procurement; operations and maintenance; other funding; and non-DOD funding. Across the DOD enterprise, 67.2% of total funds are provided to academia via grants or industry via contracts.

‡ ARL's budget figure is for FY 2009. JHU-APL and MIT-LL budget figures are for FY 2011.

§ Budget figures for LLNL, LANL, and Sandia include non-DOE funding and DOE funding for the laboratory and the site office.

According to the relevant section of the Federal Acquisition Regulation (48 C.F.R. 35.017), FFRDCs must (1) meet a special long-term government R&D need that cannot be met as effectively by the government or the private sector; (2) work in the public interest with objectivity and independence, and with full disclosure to the sponsoring agency; (3) operate as an autonomous organization or identifiable operating unit of a parent organization; (4) preserve familiarity with the needs of its sponsor(s) and retain a long-term relationship that attracts high-quality personnel; and (5) maintain currency in field(s) of expertise and provide a quick response.

UARC are research organizations within a university or college that receive sole-source (non-competitive) funds in excess of \$6 million annually (DOD 2010). In 2012, there were 14 UARCs; 13 were sponsored by DOD and one, by the National Aeronautics and Space Administration (NASA).³ Though some of these institutions were formed much earlier (e.g. 1942 in the case of JHU-APL), the UARC concept was formally established in 1996. UARCs share some of the same core characteristics as FFRDCs, such as the requirement to maintain a long-term strategic relationship with their sponsor agencies and operate free from conflicts of interest (Director of Defense Research and Engineering (DDR&E) 1996). However, FFRDCs tend to be more highly regulated than UARCs. For example, DOD's FFRDCs have limits on the annual levels of research effort at each institution.

UARCs must be affiliated with a university, have education as part of their overall mission, and have more flexibility in the types of contracts and research they are able to pursue (Hruby et al. 2011). Since FFRDC and UARC researchers are not Federal Government employees, they are subject to fewer restrictions than GOGO scientists. Depending on the specifics of their sponsoring agreements, contracts with the government, and internal practices, some FFRDC and UARC employees can assert copyrights, consult with industry, and participate in start-ups based on technology developed at the laboratory. See the Federal laboratory governance primer in Appendix A for details.

3. Motivation for the Study

Many of the Federal security laboratory governance structures in place today were developed decades ago. OSTP would like to ensure that the present mix of structures is sufficient given current and potential future security threats the United States faces. In addition, several trends affecting science and technology will likely place more pressure on Federal security laboratories and could have important consequences for national security R&D. Table 2 provides an overview of the trends that motivated this study and indicates why the potential effects of these trends are acute for national security R&D today.

³ In October 2012, the University of Nebraska and United States Strategic Command entered into a partnership to create a new UARC. See <http://nebraska.edu/docs/releases/UARCbackground.pdf>.

Table 2. Science and Technology Trends Motivating Study

Trend	Effect	Why Acute for National Security Today
Rise in Complex Systems	Multi-disciplinary and complex threats create situations where laboratories must adapt from historic traditional R&D roles towards interdisciplinary approaches.	While Federal security laboratories have had a long history of using large, multidisciplinary teams to address complex problems, funding constraints may lead to stove-piping because each unit wants to ensure their own researchers are supported.*
Globalization of Science and Technology	International R&D expertise is seen as a substitute for U.S. expertise; international competition often has cost advantage over U.S. R&D.	Private companies that support (or manage) Federal laboratories may have a cost incentives to outsource science and technology activities to cheaper sources outside the United States. This pressure may result in lack of focus in supporting U.S.-based expertise which is required to fulfill the national security mission of the laboratories.
Funding Constraints	Concern over Federal deficit has led to uncertain budgetary future for national security agencies and private sector partners.	National security science and technology is in an even more precarious position since it must compete within mission agencies for limited resources with operational missions, personnel costs, acquisition programs, and stewardship of critical defense assets (i.e. nuclear stockpile).
Increasing Mobility of Workforce	Researchers are more capable of exporting their skillsets to other industries that benefit from their specialized training, leading to increased competition for high-quality scientists.	Federal security laboratory researchers are sought by private sector competitors for their specialized expertise. Conversely, laboratories may draw upon private sector expertise to augment organic capabilities, but lack of streamlined laws, regulations and policies for interaction limit mobility and collaborative capacity.
Growth of Commercial Science and Technology Sector, Rise of Technology Wages, Growing Demand for STEM workers	Commercial enterprises (domestic and international) require increasing numbers of scientific experts in fields that are similar to national security fields; this demand increases competition for talent and wage pressure on the laboratories.	Federal security laboratories and the private science and technology enterprise are in direct competition for the same high-quality researchers. Due to Federal budget constraints, Federal employees and contractor employees of Federal laboratories have been subject to pay freezes, making it more difficult to compete with the private sector.
Increase in Foreign Graduate Students	U.S. academic institutions are increasingly graduating foreign graduate students; these students either need to retain immigration status or return to their home country.	Only U.S. citizens are eligible for security clearances, which is generally required for employment at Federal security laboratories. High quality foreign scientists that have been trained in U.S. academic institutions are unable to support the laboratories' national security mission due to their security clearance status. These high quality scientists either return to their home country or go to the private or academic sector.
Shifts in Academic Education priorities	Academic institutions have increasingly graduated students in popular academic fields (e.g. life and health sciences) that do not directly support the traditional physical science national security R&D enterprise needs.	Fewer scientists trained in the past 1-2 decades have the skill sets necessary to support the traditional national security missions of the Federal security laboratories. This has resulted in a smaller set of recently graduated scientists qualified for these roles.

* National Academy of Sciences (2004).

4. Objectives

This study addresses three questions to help OSTP assess the relationship between Federal security laboratory governance structures and laboratory operation and outcomes.

1. What are the critical trends facing Federal security laboratories today?
2. How does the governance structure relate to the operation and performance of research and development that supports the national security missions?
3. How can the Federal Government best equip the Federal security laboratories to address future national security challenges?

B. Study Design

A qualitative study based on expert opinion was chosen as the method for this study given the breadth of laboratories and governance models to be addressed. Also, the ability of output and outcome metrics for science and technology, such as patent and citation counts, to reflect the true performance of Federal security laboratories has been questioned (Marshall 2009). Federal security laboratories pose additional challenges for conducting comparative analysis due to their diversity in areas of science and technology, maturity of research (basic versus applied), size, budget, mission, and agency culture (U.S. Congress 1989).

The study team first reviewed literature and engaged current and former Federal security laboratory managers and customers in individual, panel, and group discussions to identify how governance models affect critical laboratory operations and performance characteristics. Henceforth in this report, these experts are referred to collectively as “panelists.”

1. Panelists

The study team convened four expert panels of 6 to 11 participants each during workshops held in April and May 2012. To ensure multiple viewpoints were gathered, the team also held a series of one-on-one discussions with 11 individuals unable to attend the workshops and met with the DOE Chief Research Officers at their 2012 meeting in Washington, DC. The participants consisted of laboratory leadership from the DOD, DOE, DHS, industry, academia, and agency-level offices. The team attempted to ensure participation by knowledgeable stakeholders from each agency with Federal security laboratories, the defense industry, and laboratories of each governance type. Government participants in the first three panels consisted primarily of former laboratory leaders and agency staff; the last panel was primarily current laboratory directors.

Figure 1 shows the numbers of panelists the study team consulted by category. Table 3 shows the organizations represented by panelists, and Appendix E provides a list of all panelists by name and affiliation.

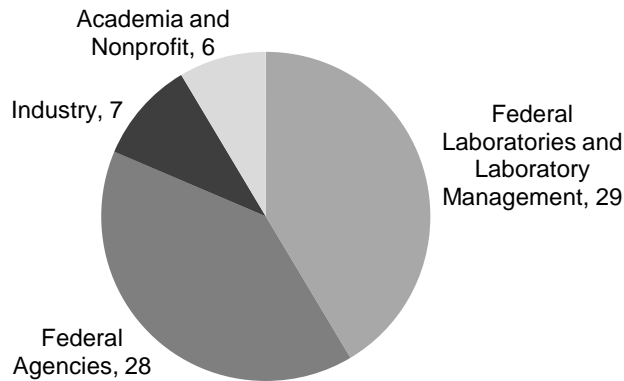


Figure 1. Number of Panelists by Organization Type

Table 3. Organizations Represented by Panelists

Federal Laboratories and Laboratory Management	Federal Agencies
<ul style="list-style-type: none"> • Army Research Laboratory • Battelle Memorial Institute • Carnegie Mellon University Software Engineering Institute • Johns Hopkins University Applied Physics Laboratory • Lawrence Livermore National Laboratory • Los Alamos National Laboratory • National Biodefense Analysis and Countermeasures Center • Naval Research Laboratory • Oak Ridge National Laboratory • Pacific Northwest National Laboratory • Sandia National Laboratories • Universities Research Association (Fermi National Accelerator Laboratory) 	<ul style="list-style-type: none"> • Department of Defense, Office of the Assistant Secretary of Defense for Global Strategic Affairs • Department of Defense, Office of the Assistant Secretary of Defense for Research and Engineering • Department of Energy • Department of Energy, National Nuclear Security Administration • Department of Homeland Security • National Aeronautics Space Administration • National Institutes of Health • Office of Science and Technology Policy • U.S. Air Force, Office of Deputy Assistant Secretary of the Air Force for Science, Technology and Engineering • U.S. Navy, Office of Deputy Assistant Secretary of the Navy for Research, Development, Testing and Evaluation • U.S. Army Corps of Engineers
Academia/Nonprofit	Industry
<ul style="list-style-type: none"> • Harvard University • Howard Hughes Medical Institute • National Academy of Engineering • Purdue University • University of California, Berkeley 	<ul style="list-style-type: none"> • Boeing • DuPont • General Atomics Corporation • K&L Gates • Lockheed Martin • Microsoft

2. Literature Review

The study team conducted a literature review to serve as the basis for preparing background materials provided to panelists. These materials consisted of a Federal laboratory governance primer (Appendix A), a discussion guide (Appendix B), and an annotated bibliography (Appendix C).

The panel discussion guide covered three main topic areas:

- Trends affecting Federal security laboratories' operation and performance—primary science and technology trends, appropriate balance of national security work at laboratories in different sectors, and personnel-related issues.
- Laboratory roles and governance structures—the roles of Federal laboratories in U.S. national security R&D enterprise, characteristics of successful Federal laboratories, and advantages and disadvantages of each governance structure.
- Preparing for the future—implications of transitioning to another governance structure and methods for instituting best attributes of each governance type.

The remaining sections of this report (C through E) summarize the observations and recommendations from panelists in these main areas and indicate where the concepts discussed are supported by the literature. Because discussions occasionally deviated from both the main topic areas and the discussion guide in Appendix B, not every topic in the guide is represented in the findings.

No other study identified in the literature addressed the full set of questions posed to panelists for this study, though some panelist recommendations are similar to those found in previous work. Appendix D provides findings of a meta-analysis of recommendations from reports on Federal laboratories from the past two decades. Findings are presented by theme and source.

C. Trends Affecting Federal Security Laboratories

The first component of the panel sessions focused on the overarching trends that have directly or indirectly affected R&D activities or performance at the Federal security laboratories. The trends discussed are organized into four areas: (1) personnel-related challenges, (2) competition from R&D entities in foreign countries, (3) changes to laboratory research focus and funding, and (4) increases in regulatory requirements and oversight.

1. Personnel-Related Challenges

Current personnel challenges for Federal security laboratories have resulted from several long-term trends, including competition from the private sector, an aging workforce, and waning numbers of appropriately educated and security clearance-eligible young scientists. These trends led panelists to express concerns over the ability of the

Federal security laboratories to maintain a high-quality workforce. Panelists concurred with National Research Council (NRC) findings that the Federal security laboratories remain a desired location for individuals looking to pursue intellectual challenges and public service (NRC 2012). However, questions were raised over the ability of the Federal security laboratories to compete with the private sector for top-quality talent, particularly for certain high-demand fields, such as cybersecurity. In addition, the median age of the workforce is over 40 and has been steadily rising (Townsend, Kerrick, and Turpen 2009). For example, aerospace Federal security laboratory personnel are primarily mid- or late-career professionals, and young scientists have not been hired in sufficient numbers to replace aging researchers (JASON 2008). These trends have been documented by laboratory managers in a recent report (NRC 2012).

According to panelists, the lack of new scientists with the appropriate education and eligibility to obtain a security clearance represents another long-term challenge for Federal security laboratories. There are increasing numbers and proportions of foreign-citizen undergraduate and graduate students in U.S. academic institutions who are incapable of obtaining security clearances. According to the Defense Science Board (DSB), non-U.S. citizen doctoral graduates with temporary visas are outpacing U.S. citizen and permanent resident doctoral graduates in national security science and technology fields at U.S. academic institutions (DSB 2012). In addition, panelists asserted that students from top academic institutions increasingly graduate from programs that do not directly support the national security responsibilities of the Federal laboratories (e.g. physical sciences in support of nuclear stockpile maintenance, explosives research, and aeronautics). This trend was also described by Decker et al. (2012), who noted a decline in the production of physical scientists, which has historically been a key personnel need for Army research activities. Panelists discussed the responsibility of the laboratory system to address longstanding national security priorities, but they also recognized that this trend may contribute to the laboratories' difficulty in hiring researchers in emerging national security science and technology fields, such as cybersecurity, energy security, and bioterrorism (NRC 2012; JASON 2008).

Additional analyses could be undertaken to quantify the personnel trends cited above and to put shortfalls in the "supply" of eligible scientists in the context of expected future "demands" for R&D activities related to national security. Such work could support renewed policy design efforts that have previously proven difficult to implement, in part because of an incomplete understanding of the supply and demand functions for national security scientists.

2. International Science and Technology Competition

Panelists discussed how U.S. technology companies are at a significant cost disadvantage relative to some technology R&D companies located overseas (especially in

China). This situation provides cost disincentives for U.S. industrial firms to conduct only U.S.-based research without expanding research operations overseas. Further, corporate R&D laboratories have reduced their U.S. commitment to high-risk, long-term research, and they have redirected some of these resources to overseas laboratories with lower cost facilities (Townsend, Kerrick, and Turpen 2009). Among the private companies that have chosen to locate laboratories overseas to take advantage of the increasing quality of foreign academic institutions and their graduates are GE, Microsoft, IBM, and Yahoo! (DSB 2012).

This trend toward locating research activities overseas does not directly pose a risk to the classified national security portfolio of the Federal laboratories (except as a competitor for talent). However, panelists expressed concern about the reduced opportunities for laboratory researchers to interface with foreign-based researchers and internationally located industry collaborators. In particular, scientists at Federal security laboratories were said to have difficulty collaborating with researchers overseas due to security requirements and current budget pressures to reduce travel for conferences and peer engagements. Panelists explained that this issue becomes particularly worrisome when prominent subject matter experts locate overseas. Also, panelists warned that the increasingly global nature of technology activities could strain relationships among Federal security laboratories and private companies when addressing U.S. national security research needs.

3. Changes to Laboratory Research Focus and Funding

According to some panelists, emerging national security fields such as cybersecurity, information technology, quantum computing, bioterrorism and bioweapons, and nanotechnology have not been adequately addressed by Federal security laboratories. The larger national science and technology enterprise is responding to these challenges at a more rapid pace than Federal security laboratories (Decker et al. 2012). In attempting to explain why Federal security laboratories have not kept pace in some emerging technical fields, panelists noted that during the 1990s and 2000s, national research priorities and funding moved toward health sciences and away from traditional scientific disciplines supporting the national security research enterprise. Other panelists thought the issue was not a lack of agility in pursuing new fields but that the Federal security laboratories were overwhelmed by the changing national security priorities and accelerating pace of global technological advancements. Thereby creating uncertainties about future research directions and needed technical expertise (Townsend, Kerrick, and Turpen 2009; JASON 2008; DSB 2012).

In light of the varying views among panelists regarding the extent to which security laboratories have been unable to keep pace with evolving scientific disciplines, additional quantitative analyses might contribute to improved understanding of the role of national R&D planning and prioritization's impact on Federal security laboratories. This would

provide an analytical basis for laboratory directors and Federal science and technology policymakers to more effectively implement policy changes or mitigate adverse effects of changing R&D foci.

Panelists discussed two funding-related trends that have challenged the DOD and DOE laboratories' ability to conduct their research—the increasing fragmentation of budgets and reliance on shorter-term funding rather than long-term programmatic funding. One example is the earlier DOE Weapons Supported Research programs. Weapons research programs historically provided laboratory management with large general budgets and independence over how research was conducted and the topics studied. According to panelists, the current “atomization” of research budgets is due both to increases in congressional oversight and to changes in departmental budgeting and accounting practices. Panelists recognized that budget transparency is necessary, but felt that the resulting lack of autonomy and flexibility—in pursuing research directions at Federal security laboratories—is unwarranted. Some of the literature also recommended reducing the number of budget categories (NRC 2012) and increasing local budgetary control (Decker et al. 2012; NRC 2012; DeYoung 2009). According to panelists, the impact of this funding fragmentation primarily affects researchers who must compete or look elsewhere for funding. Panelists also thought that current funding practices hinder laboratory managers' abilities to maintain national security-related core capabilities. They described a system where in order to preserve national security core capabilities, laboratory managers are required to be creative and use their work for non-sponsor agencies to maintain consistent funding for researchers.

This last observation points to another kind of challenge—and complexity—in dealing with some of the issues that panelists raised. Prior policy decisions in response to declining overall budgets may have led to an unintended consequence where directors must rely upon outside funding support to maintain core capabilities. This is a key example where policies and practices implemented for one purpose at one point in time may create larger-than-intended (or in some cases unintended) consequences on stakeholders years later.

This is another area where additional analyses could be undertaken to gain a better understanding of the character of and motivation for the revised funding practices, and to assess quantitatively the effects of such budgetary actions on the health of Federal security laboratories.

4. Increase in Regulatory Requirements and Oversight

Panelists were also concerned about the increasing levels of bureaucracy and rising regulatory burden on laboratory researchers (DSB 2012; NRC 2012). Panelists suggested that researchers in the DOE Office of Science, the DOE National Nuclear Security Administration (NNSA), and the DOD laboratories all face many more regulatory

requirements related to safety than non-Federal laboratories despite historically low levels of accidents. Some panelists noted that increases in regulatory requirements often represented the cumulative effects of multiple remedial actions, each one taken in response to a single incident that was considered a liability to the laboratories or their sponsor agencies. One adverse effect of this growing reporting burden is a perceived level of distrust between the agency offices and the laboratory staff conducting research.

In particular, panelists pointed to the increasingly strained relationship between the NNSA FFRDCs and the DOE, their sponsoring agency. Some panelists surmised that NNSA laboratories are slowly being “federalized” through strict agency oversight. A recent NRC report recommended rebuilding trust between the laboratory managers and the agency; setting clearer management boundaries; and minimizing safety, security, and budgetary oversight by the agency (NRC 2012).

D. Laboratory Roles and Governance Structures

The second section of the panel sessions focused on the role of Federal security laboratories and advantages and disadvantages of each governance structure. Panel discussions culminated in four conclusions: (1) Federal laboratories fulfill a unique role in U.S. national security R&D; (2) each governance model has certain advantages; (3) critical laboratory characteristics do not necessarily depend on governance structure; and (4) exemplar and substandard examples of each governance model exist.

1. Role of Federal Laboratories

Panelists described Federal security laboratories as institutions that fulfill a unique role in U.S. R&D. They are able to conduct long-term, multidisciplinary projects on classified and unclassified topics; build, maintain, and use expensive tools; support the transitioning of technologies to specific national security programs; and assume risks of hazardous operations. For a variety of reasons, other types of laboratories (e.g. academic and private research institutions other than FFRDCs and UARCs) cannot carry out these functions as effectively as Federal security laboratories. The Federal laboratories also currently provide the nation with a high-quality science and technology workforce, without conflicts of interest, that is ready to respond to national security needs or national emergencies (Hruby et al. 2011). DOD national security laboratories often fulfill the role of a trusted advisor in agency technology acquisitions decision making (DeYoung 2009). Federal security laboratories can tackle dangerous topics, such as research related to nuclear weapons, which would otherwise provide unacceptable risks to private-sector companies or universities.

2. Advantages of Each Governance Model

According to panelists, each governance model has advantages and disadvantages. One of the most cited benefits of the FFRDC and UARC models over the GOGO model is flexibility of personnel management. FFRDCs and UARCs can use private-sector hiring, promotion, and firing practices; provide competitive salaries; and some institutions (depending on sponsoring arrangements) allow their employees to consult with industry, participate in start-ups, and more (Hughes et al. 2011; DSB 2012). On the other hand, panelists asserted (and the literature concurs) that GOGO laboratories would experience improved recruiting and retention of scientists and engineers if they had more flexibility in their personnel management systems (JASON 2008; Chait 2009). According to panelists, FFRDCs and UARCs can offer higher salaries because they are not part of the Federal personnel system. However, they also asserted that GOGO laboratories tend to be less expensive for customers than FFRDCs and UARCs due to the higher personnel costs associated with the FFRDC/UARC personnel management model.

Panelists stated that DOE FFRDCs enjoy greater flexibility of funding through the Laboratory Directed Research and Development (LDRD) program compared to GOGO laboratories. Historically, LDRD has been a powerful tool for attracting new talent and equipping laboratory managers with the ability to branch out into new research areas or maintain existing research capabilities (NRC 2012). DOD GOGO laboratories have similar LDRD-like programs through In-house Laboratory Independent Research and Section 219,⁴ but panelists believed these mechanisms have not yet been used to their full potential (Decker et al. 2012).

Some panelists saw differences among the three laboratory models (GOGO, FFRDC, and UARC) in the abilities of laboratory directors to develop trusting relationships with the agencies that oversee them. For example, some panelists stated that DOD laboratories must be GOGOs to serve as “honest brokers” or “smart buyers” in the acquisition process, and these statements are echoed in some of the literature (Chait 2009; DeYoung 2009). Other panelists noted that some UARC laboratories sponsored by the military departments are similar to the GOGO labs in this regard. On the other hand, according to panelists, DOE is able to use FFRDC laboratories almost exclusively because most manufacturing of nuclear weapons components is performed in-house at sites such as the NNSA’s Pantex Plant. Thus, DOE laboratories are not often required to provide “smart-buyer” support for acquisition programs.

⁴ Section 219 of the 2009 National Defense Authorization Act provides the Secretary of Defense the authority to use not more than 3 percent of available funds for innovative basic and applied research to support military missions, fund development programs that support transition of technologies into operational use, and fund workforce development activities to improve the capacity of the defense laboratory to recruit and retain science and engineering personnel.

3. Laboratory Characteristics not Dependent on Governance Structure

Panelists stated that many laboratory issues do not depend on governance structure. Instead, they depend on resources in the associated industry or sector, and there is often variability within a single laboratory. For example, Johns Hopkins University Applied Physics Laboratory, a UARC, has research departments with more freedom and flexibility than others. Competition for facilities and infrastructure funding differs between DOD and DOE laboratories. DOD laboratories must compete with hospitals, barracks, runways, and roads and, therefore, tend to be lower on the priority list for military construction (MILCON) funding. In contrast, the DOE laboratories must compete among themselves when dividing the congressional line items for facilities and infrastructure. Panelists asserted that this situation, which is due to differences in agency mission and structure, would exist regardless of the governance structure.

Panelists expressed their belief that high-quality technical expertise and a trusting relationship between laboratory leaders and their sponsor agencies were important to the success of FFRDC laboratories. The trusting relationship mentioned previously as a characteristic of many GOGOs and UARCs also exists at certain FFRDC laboratories, including the Massachusetts Institute of Technology Lincoln Laboratory (MIT-LL).

Panelists asserted that a spectrum of closeness exists between Federal security laboratories and their customers, ranging “from inspired to [closely] led to micromanaged.” The most effective customers and sponsors set only “the what” (research objectives to be met) and allow the laboratories to determine “the how” (specific research projects and procedures). Panelists from laboratories of all governance structure types expressed their beliefs that leadership of their sponsor agencies lacked technical expertise, a factor that impedes the development of trusting relationships.

4. Each Governance Model Has Exemplar and Substandard Examples

Panelists agreed that world-class laboratories exist under all three governance structures. They also pointed out that there are highly successful and less successful examples of laboratory management within each governance structure. In addition, a Federal security laboratory may do extremely well in terms of one measure of success but perform poorly in another.

For example, panelists discussed exemplar and substandard management of FFRDCs. MIT-LL was often cited as an exemplar FFRDC. MIT-LL maintains close relationships both with its parent university, which manages its contract, and with its sponsor, the DOD. Other factors that panelists thought were likely to contribute to MIT-LL’s success included its ceiling on headcount and funding for sponsor-funded research, discretion on which research projects to pursue, and relatively minimal Federal oversight. MIT-LL has also developed a personnel ranking system in an attempt to ensure its scientists and engineers maintain a high standard of work.

In contrast, panelists discussed the “micromanagement” of the NNSA FFRDCs, whereby the agency determines the precise requirements rather than allowing the laboratories to establish their own processes. Each NNSA FFRDC has over a hundred Federal employees on-site and (in the view of panelists) is subject to excessive numbers of external audits every year. As noted previously, a recent NRC report included similar observations and made recommendations aimed at rebuilding trust between DOE and its FFRDCs, establishing clear management boundaries, and reducing government oversight (NRC 2012).

E. Preparing for the Future

According to panelists, wholesale transition of all Federal laboratories from one governance structure to another is not advisable or warranted, but the best attributes of each governance structure could be incorporated in others. The predominant viewpoint of panelists was that the costs associated with transitioning all Federal laboratories to one governance structure would far outweigh the benefits. Panelists believed that such changes in management are disruptive and may leave lasting negative impacts.

Even management changes that do not alter the basic governance concept can be disruptive. The 2012 NRC review of the NNSA laboratories’ post-contract transition stated that the transition from an FFRDC run by a nonprofit parent organization to an FFRDC run by a consortium including for-profit contractors at LANL and LLNL led to staff frustration, a temporary increase in science and engineering staff turnover, and an increase in the costs of the two contracts by roughly \$200 million per year. These increased costs stemmed from management-fee increases, changes in health and pension benefits, and differences in state and local tax obligations (NRC 2012). Panelists also pointed out that the relationship between laboratory management and the DOE has suffered from a lack of openness since the re-competition.

Panelists argued that modifying laboratory governance structures would not necessarily solve problems at Federal security laboratories. Leadership gaps and lack of trust between laboratory leadership and agency overseers were driving factors for observed operations and management problems. Panelists asserted that when operations and management problems previously arose, changing the governance structure did not fill these leadership gaps, and there was no reason to expect changes in governance structure would lead to a different result. One leadership issue panelists raised was the mismatch between the pace of laboratory director turnover and the time required to implement a revised science and technology strategy at a laboratory. Panelists felt that while some past laboratory directors had clear visions for a science and technology strategy at their laboratories, their tenures were too short to allow them to fully develop and implement their goals (NRC 2012).

Panelists provided three recommendations for improving Federal security laboratories: (1) rationalize the oversight burden on the laboratories, (2) maintain or reinstitute laboratory flexibility for research budgeting, and (3) increase or maintain autonomy and accountability in personnel systems (particularly in GOGO laboratories). Panelists acknowledged that the recommendations do not apply equally to all laboratories or governance models.

1. Rationalize the Oversight Burden on the Laboratories

Panelists recommended minimizing detailed technical and administrative oversight of the laboratories and improving relationships between laboratories and their sponsors. Panelists believed that some laboratories have about the right level of oversight today, and those laboratories could serve as a model for others. For example, the NASA Jet Propulsion Laboratory has 30 Federal employees on site and LLNL has 130, though the laboratories' budgets are similar in size (Miller 2012). To the extent practical, panelists suggested standardizing and simplifying the regulatory and audit practices and standards across similar types of Federal security laboratories. For example, panelists thought all laboratories could follow the standards set by the International Organization for Standardization. To improve mutual understanding and to help build trust between laboratories and their sponsoring agencies, panelists proposed increasing personnel exchanges through expanded use of the Intergovernmental Personnel Act and other personnel exchange mechanisms. These recommendations apply to laboratories of all governance structures and are reinforced by the literature (Government Accountability Office (GAO) 2008; NRC 2012; DSB 2012; DSB 1994).

2. Maintain or Reinstitute Laboratory Flexibility for Research Budgeting

Panelists agreed that research freedom and flexibility are critical for maintaining motivated and satisfied scientists and engineers, and for sustaining a productive, well-functioning laboratory. They strongly suggested reversing the “atomization” of research budget oversight and providing laboratories with greater control. To a certain extent, this is possible today at the DOE through the LDRD program and at the DOD through the In-house Laboratory Independent Research program and Section 219. At LANL, these programs allow the director discretion to invest in long-term strategic research projects. However, independent research budgets are not used to the full extent authorized by law, particularly at DOD laboratories (Decker et al. 2012). Panelists recommend continuing or increasing independent research budgets and decreasing excessive detailed budgetary oversight; this recommendation is also suggested in the literature (DSB 2012; Decker et al. 2012; NRC 2012; JASON 2008).

3. Increase or Maintain Autonomy and Accountability in Personnel Systems

Panelists uniformly supported continuing the personnel system autonomy of FFRDCs and UARCs and increasing the flexibility of personnel systems at GOGO laboratories. At FFRDCs and UARCS, if a researcher is not performing at a certain level, management has the option to promptly terminate his or her employment, ensuring a high level of quality is maintained. Ideally, panelists would give laboratories the freedom to more rapidly hire the most qualified scientists and engineers, with expedited processing of security clearances; reward superior performance through promotion and raises; and penalize poor performance through demotion, pay cuts, or termination. Panelists recommended continuing and expanding the Laboratory Personnel Demonstration Projects, which allow streamlined job classifications, greater flexibility in assignments, and increased authority to set pay. This recommendation is echoed in the literature (DeYoung 2009; Decker et al. 2012; National Academy of Sciences (NAS) 1994; National Technical Information Service (NTIS) 1991).

4. Additional Recommendations

Panelists provided additional policy recommendations across several categories to further expand the best attributes of each governance model to all Federal laboratories (see Table 4). The categories are mission clarity and research strategy, agency oversight, regulatory standards, personnel initiatives, funding mechanisms, and collaboration. (See Appendix D for information on how panelist suggestions compare to recommendations from past reports.)

Table 4. Panelist Policy Recommendations for Incorporating Best Practices of Each Governance Model

Issue by Category	Panelist Policy Recommendation
Mission Clarity and Research Strategy	
Lack of research budget independence at laboratory level	Maintain or increase research independence (Section 219 for DOD and LDRD for DOE).
No interagency national security science and technology strategy	Set interagency mission strategy for all Federal laboratories through interagency action
Agency Oversight	
Lack of trust, communication, and understanding between laboratory and oversight agency	Increase use of existing mechanisms or create new mechanisms for staff to rotate between laboratory and headquarters
Lack of institutional memory at oversight agency	Modify staffing practices or policy to retain long-term personnel at headquarters Utilize advisory committees of internal and external personnel to provide institutional memory
Lack of technical capability at oversight agency	Facilitate additional technical training for headquarters staff or increase rotations
Regulatory Standards	
Additional layer of regulatory requirements imposed by oversight agency for certain Federal laboratories	Implement oversight standards that are in line with other laboratory systems, such as industry standards
Laboratories spending inordinate amount of time complying with requirements and responding to audits	Develop an adaptive oversight mechanism, implement increased oversight on site-by-site basis as needed, or relax oversight on historically high performing laboratories
In response to crises at single site, system-level policies are implemented	Establish policy review before implementing new oversight policies to understand whether system level or site-specific policy is required
No mechanism for laboratory feedback on oversight agency	Develop policy for laboratories to provide regular feedback to site offices and headquarters level to make those offices accountable as well

Issue by Category		Panelist Policy Recommendation
Personnel Initiatives		
Rigid personnel systems at GOGOs makes it difficult to hire and terminate personnel		For GOGOs, investigate and implement flexible approaches for addressing poor performance, such as negative raises, and term work
Student program investment has been decreasing		Expand and formalize student recruitment and retention programs with sustained funding levels
DOD Science and Technology Reinvention Laboratories (STRL) are not all using their personnel demo authority fully		Adopt flexibilities of existing STRL demonstration projects at all STRL laboratories
Laboratory director tenure is too short to achieve strategic vision		Lengthen the tenure of laboratory directors to allow them time to implement strategic vision
Funding Mechanisms		
Barriers to Work for Others (WFO) exist at certain laboratories		Formalize a research portfolio approach with a strategic WFO plan to sustain core capabilities and reduce barriers for competitive WFO
Increasing fragmentation of budgets		Revise budgeting process to reduce categories of funding allocated, without decreasing overall funding levels
Collaboration		
Federal security laboratories benefit from academic rotations		Increase partnerships with universities and faculty rotations in Federal laboratories and the reverse
Federal security laboratories benefit from industry work share		Increase the use of cooperative R&D agreements, material transfer agreements, facility use agreements, and WFO agreements

Appendix A.

Federal Laboratory Governance Primer

Introduction

This appendix serves as a primer to each of the U.S. Federal laboratory management structures—Government-Owned/Government-Operated (GOGO) laboratories and non-GOGO laboratories, including Federally Funded Research and Development Centers (FFRDCs) and University Affiliated Research Centers (UARCs). Different agencies have their own nomenclature for Federal research facilities. For example, within the Department of Defense (DOD) and Department of Energy (DOE), facilities are referred to as “laboratories,” whereas National Aeronautics and Space Administration (NASA) facilities are called “centers.” Each government agency oversees (but may not manage) its own Federal laboratories, but four agencies—the DOD, Department of Health and Human Services, NASA, and DOE—receive the majority of Federal R&D intramural dollars (National Science Foundation (NSF) 2012). As a result, a wide variety of managing legislation and regulation govern the Federal laboratories. The United States Government has founded close to 1,000 Federal laboratories since the establishment of the first laboratory in 1846.

Government-Owned/Government-Operated Laboratories

The majority of all the Federal laboratories and about half of the approximately 80 major Federal security laboratories are GOGOs. The personnel of GOGO laboratories are predominantly government employees, and the laboratories must comply with Federal personnel hiring practices. As such, GOGO researchers are subject to more constraints than their university or non-GOGO counterparts. Certain employees have flexibility by virtue of being dual appointees (university and GOGO).

The first GOGO, the Smithsonian Institution, was established in 1846 (Congressional Research Service (CRS) 2009). The Naval Research Laboratory is the oldest of the military service laboratories, dating back to 1923. Note, however, that until the 1960s, the Army had a research facility at Watertown Arsenal that had been in existence since 1820.

GOGO laboratories may be created by Congress or unilateral agency action. The primary vehicle for DOD GOGO dissolution and transformation has been the series of closures and realignments that have resulted from recommendations of the Defense Base Closure and Realignment Commission. (Both the commission and the actions resulting

from commission recommendations are commonly referred to as BRAC.) The 1991 BRAC consolidated nine Army laboratories under a single command, resulting in the Army Research Laboratory. Later BRAC actions led to the Air Force consolidation of its laboratories into four “super” laboratories and the Navy consolidation of its four warfare centers.

Non-Government-Owned/Government-Operated Laboratories

Non-GOGO laboratories are owned or sponsored by the Federal Government, but managed by contractors. Subsets of Non-GOGO laboratories are designated as FFRDCs or UARCs. Since non-GOGO researchers are not Federal Government employees, they enjoy more freedom than GOGO scientists. Non-GOGO employees can assert copyright, consult with industry, and participate in start-ups based on technology developed at their laboratories. While most Federal laboratories are GOGO, all but one of DOE’s laboratories (National Energy Technology Laboratory) are FFRDCs.

Government-Owned/Contractor-Operated

The concept of a GOCO laboratory dates back to the original laboratories of the Manhattan Project during World War II, including what are now known as Los Alamos National Laboratory and Oak Ridge National Laboratory. In the mid-1980s, these DOE GOCO laboratories and their DOD equivalents, Federal Contract Research Centers, along with existing FFRDCs, were combined in the first formal codification of FFRDCs in a policy letter issued by the Office of Management and Budget (OMB) Office of Federal Procurement and Policy (OMB 1984, 14462).

Although several decades have passed, the term GOCO is still used to describe the DOE and other agencies’ laboratory sites that are partially or wholly owned by the government, but managed by a contractor. However, the DOD uses GOCO to specifically denote a manufacturing plant owned by the DOD and operated under contract by a private organization (Joint Staff 2010). GOCO is also used as an adjective. To avoid confusion, the main text of this report contains the terms FFRDCs and UARCs, rather than the potentially misleading term GOCO.

Federally Funded Research and Development Centers

FFRDCs are independent, private-sector organizations sponsored and funded by the Federal Government to meet special, long-term research or development needs that cannot be met as effectively by existing government or contractor resources. Parent organizations that run FFRDCs may be individual universities, university consortia, nonprofit corporations, industrial firms, or hybrid organizations. Increasingly, contractors are using a hybrid of more than one type of organization to manage and operate FFRDCs. There are currently 39 FFRDCs across 11 agencies. (For a master list of FFRDCs, see

<http://www.nsf.gov/statistics/ffrdclist/start.cfm>.) The DOE laboratories, commonly referred to as “national laboratories,” are almost all FFRDCs (16 out of 17).

The FFRDC concept grew out of World War II experiences, where private-sector scientific, engineering and analytic talent was brought to bear to an unprecedented extent—and in new organizational ways—in support of U.S. wartime efforts. After the War, the Federal Government sought to retain close ties to the nation’s technical expertise. Over several decades, the FFRDC concept was refined to meet continuing government needs in evolving security and regulatory environments. At their peak in the late-1960s and early 1970s, FFRDCs numbered 74 throughout the government, including 43 within the DOD alone. In 1969, the Mansfield Amendment to the Military Authorization Act set forth a stipulation that prohibited the DOD from funding research that was not for an explicit military purpose. As a result, several FFRDCs were terminated, and others transitioned to other management structures. Today, the key characteristics of FFRDCs are broadly defined in Federal Acquisition Regulation provisions (summarized below), though sponsoring agencies vary somewhat in the specific governance mechanisms and policies applied to their FFRDCs (see, for example, the Department of Defense FFRDC Management Plan, Apr 2011).

Current FFRDC requirements are codified in the previously mentioned policy letter (OMB 1984) and in the Federal Acquisition Regulation (48 C.F.R. 35.017). FFRDCs can be Contractor-Owned, Contractor-Operated (COCO), GOCO, or some combination thereof. FFRDCs must: (1) meet a special long-term government R&D need that cannot be met as effectively by the government or the private sector; (2) work in the public interest with objectivity and independence, and with full disclosure to the sponsoring agency; (3) operate as an autonomous organization or identifiable operating unit of a parent organization; (4) preserve familiarity with the needs of its sponsor(s) and retain a long-term relationship that attracts high-quality personnel; and (5) maintain currency in field(s) of expertise and provide a quick response capability. FFRDCs and their employees are exempt from civil service regulations but are still subject to budgetary controls from both the sponsoring agency and Congress.

FFRDCs may be established by statute or agency action. Pursuant to 10 U.S.C. § 2367, heads of certain agencies, including the DOD, must submit a report to Congress explaining the purpose, mission, and scope of proposed FFRDCs and wait 60 days for congressional response. If an FFRDC is deemed to be no longer needed, it is discontinued or, more commonly, allowed to continue as a nonprofit or for-profit organization without the FFRDC designation.

FFRDCs are typically managed under a management and operating (M&O) contract. The M&O contract was formalized by the Atomic Energy Act of 1946, which established the Atomic Energy Commission (predecessor to the DOE) and enabled it to enter into management contracts with non-government entities. Work performed under

M&O contracts is intimately related to the long-term agency mission, and it has special requirements for work direction, safety, security, cost controls, and site management.

In 2004, to offset criticism of contractor entrenchment and lack of competition, DOE announced it would put the contracts for several of its laboratories up for bid. As a result, the contractor of Los Alamos National Laboratory changed for the first time in 60 years from the nonprofit University of California to the limited-liability company Los Alamos National Security LLC, a corporation managed by University of California, Bechtel, Babcock & Wilcox Technical Services, and URS Energy and Construction. FFRDCs are generally reevaluated on a 5-year cycle, but not necessarily re-competed every time. Table A-1 and Figure A-1 illustrate the contractor changes over the years for selected DOD and DOE FFRDCs.

Table A-1. DOD FFRDC Management

Name	Year Founded	Sponsor	Type*	Management Organization	Location
Center for Communication and Computing	1956	NSA/CSS	R&D Lab	Institute for Defense Analyses	Bowie, MD; La Jolla, CA; Princeton, NJ
MIT Lincoln Laboratory	1951	USAF	R&D Lab	Massachusetts Institute of Technology	Lexington, MA
Software Engineering Institute	1984	OSD	R&D Lab	Carnegie Mellon University	Pittsburgh, PA
Arroyo Center	1984	Army	S&AC	RAND Corp.	Santa Monica, CA
Center for Naval Analyses	1942	Navy	S&AC	The CNA Corp.	Alexandria, VA
National Defense Research Institute	1984	OSD	S&AC	RAND Corp.	Santa Monica, CA
Project Air Force	1946	USAF	S&AC	RAND Corp.	Santa Monica, CA
Studies and Analyses Center	1956	OSD	S&AC	Institute for Defense Analyses	Alexandria, VA
Aerospace FFRDC	1960	USAF	SEIC	Aerospace Corp.	El Segundo, CA

Note: R&D Laboratory stands for Research and Development Laboratory; S&AC stands for Study and Analysis Center; and SEIC stands for Systems Engineering and Integration Center.

Adapted from: Office of Technology Assessment (1995).

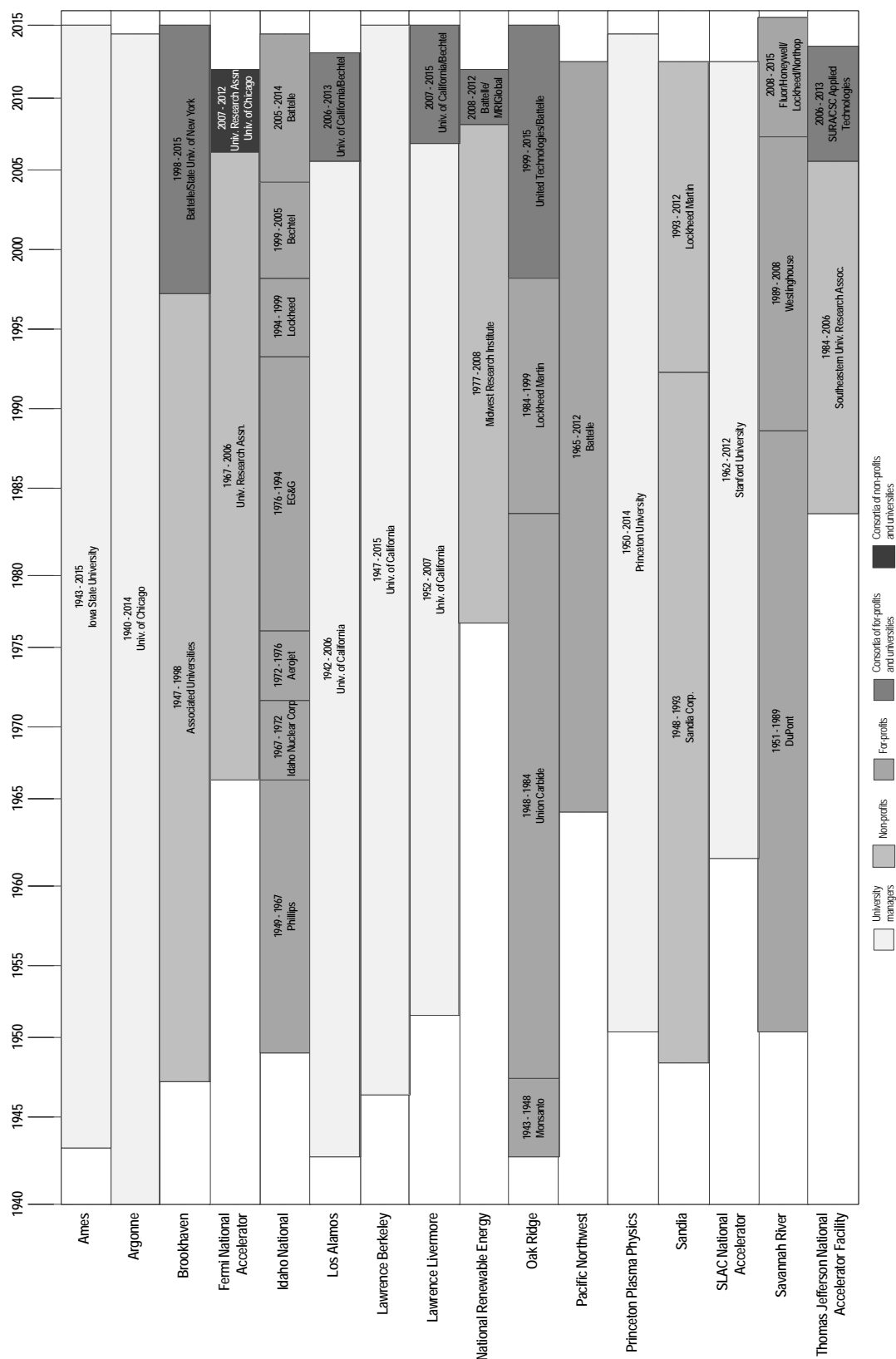


Figure A-1. DOE FFRDC Contracting History

University Affiliated Research Centers

UARC's are research organizations within a university or college that receive sole-source (non-competitive) funds in excess of \$6 million annually. UARC's receive sole-source funding under the authority of 10 U.S.C. § 2304(c)(3)(B), but may also compete for outside work unless precluded from doing so by their contracts. UARC's were formally established in 1996 with the UARC Management Plan by the Director of Defense Research and Engineering, Office of the Secretary of Defense, to ensure that essential engineering and technology capabilities of importance to the DOD were maintained (Director of Defense Research and Engineering (DDR&E) 1996). Six were originally designated in 1996, including the Johns Hopkins University Applied Physics Laboratory (JHU-APL), which had previously been an FFRDC. JHU-APL now operates under a sole-source, cost-plus-fixed-fee contract administered by the U.S. Navy's Naval Sea Systems Command. There are currently 14 UARC's, 13 in the DOD and 1 in NASA (the Ames Research Center at the University of California at Santa Cruz).

UARC's share many of the same core characteristics as FFRDC's, such as the requirement to maintain a long-term strategic relationship with their sponsors and operate free from real or perceived conflicts of interest (Director of Defense Research and Engineering (DDR&E) 1996). UARC's and FFRDC's are similar except UARC's must be affiliated with a university, have education as part of their overall mission, and have more flexibility in the types of contracts and research they are able to pursue (Hruby et al. 2011).

Appendix B.

Discussion Guide

Trends Affecting Science and Technology

1. What are the primary trends affecting science and technology?
 - a. Rise of complex systems
 - b. Globalization of science and technology
 - c. Mobility of workforce
 - d. Funding constraints
 - e. Growth in commercial sector national security S&T
2. Industry vs. Academia vs. Federal Lab's Roles:
 - a. Where is national security S&T being performed: industry vs. academia vs. government laboratories? How has this been changing over time? What has been the impact of the decline of large commercial R&D facilities?
 - b. Are the goals and objectives of national security R&D conducted by industry and Federal laboratories in agreement? Between programs and Federal laboratories?
 - c. Has there been an increase in outsourcing of government research to academia or industry? What have been the impacts?
3. Personnel-related issues:
 - a. Rise of two-career families
 - b. Declining interest in national security
 - c. Rise of technology wages
 - d. Foreign nationals
 - e. Lack of education and training for certain national security missions
 - i. How well has academia provided the personnel necessary to maintain national security R&D posture?
 - ii. Are the historic connections to academia still maintained?
4. What have been the impacts of consolidating the Service laboratories?

Governance Structures

1. What are the necessary roles of a Federal laboratory?
 - a. Conduct quality research
 - i. Basic vs. Applied?
 - ii. In support of mission vs. transfer to private sector?

- b. Serve as an honest broker for technical opinions in acquisition cycle
 - c. Provide support during a national emergency
 - d. Educate and train scientists
- 2. What are the characteristics of successful Federal laboratories?
 - a. Quality of science
 - i. Innovativeness, sustained progress, and impact on the field
 - ii. Recognition by the scientific community, including awards and invited talks
 - b. Quality of personnel
 - i. Development of collaborative opportunities across disciplines, and sectors
 - c. Performance of mission
 - d. Efficient and effective research program management
 - e. Facilities and infrastructure
 - i. Effective construction and operation of user facilities
 - ii. Proximity of laboratory to other centers of R&D to foster for cross-sector, interdisciplinary research
 - f. Ensure safety, health, security and environmental protection
 - g. What are the relative priorities of these characteristics?
- 3. Performance Metrics
 - a. Are there quantitative and qualitative measures that could be used to reliably compare across laboratories?
- 4. What are the advantages and disadvantages of each governance structure? Specifically in relation to:
 - a. Trusted advisor, reputation
 - b. Intimacy with customer/sponsor
 - c. Technology transfer
 - d. Multi-disciplinarity of work
 - e. Responsiveness
 - f. Workforce
 - i. Recruitment success
 - ii. Recruitment trends relative to private industry recruitment
 - iii. Aging workforce/Workforce Demographics
 - iv. Student Training Programs/Post-Doctoral Programs
 - g. Unique Facilities
 - h. Identification of crucial technology research areas, crucial R&D subject areas (e.g. nuclear chemistry, radar, high explosives)

Preparing for the Future

1. What S&T areas are most critical for national security going forward?
 - a. Can the roles of GOCOs and GOGO national security laboratories be logically identified with these S&T areas?
 - b. How will the transition to future S&T needs be affected by ending of wars in Iraq and Afghanistan, refocus of attention to the Pacific?
2. What is the role of outsourcing national security R&D to industry and academia in the near-future? Should we increase/maintain/decrease outsourcing of government research to industry and academia? Why?
3. *What would be the implications of transitioning laboratories from GOGOs to GOCOs, or vice-versa?*
 - a. *What capabilities are gained? What characteristics of existing laboratories may be lost?*
 - b. *How do you facilitate a smooth transition for staff?*
 - i. *Issues concerning transitioning from Federal employees to non-feds, or vice-versa*
 - c. *What are the implications if this is accomplished using a BRAC? Or analogous process for the alternative scenario (GOCO to GOGO)?*
 - d. *How do S&T mission needs and gaps overlap with governance structure advantages/disadvantages?*
 - e. *Are there other preferable options, e.g. requiring associations with a university or some other organization?*
4. *What are best practices in GOCO or GOGO management or leadership? How do we ensure these best practices are instituted:*
 - a. *In existing GOCOs or GOGOs?*
 - b. *In potential new GOCOs or GOGOs?*

For discussions taking place after May 15, 2012, questions in italics were replaced with the following to reflect the recommendations of the first two expert panels:

3. What are potential policy actions to improve governance? E.g.
 - a. Allow for longer-term mission funding (as compared to project-based funding structure)
 - i. Maintain laboratory independence over lab-directed research (e.g. LDRD programs)
 - b. Increase levels of collaboration activity at laboratories
 - i. Increase work-share programs for industry researchers
 - c. Increase technical training/expertise within oversight agency leadership
 - i. Increased sponsoring agency protection for researcher/laboratory S&T work

- ii. Exchange program for research staff between oversight agency, analogous exchange program for Service leadership and laboratory researchers
 - iii. IPA programs provide technical expertise to agency leadership when agency funding is adequate to support additional staffing
 - iv. Scientific management training program
- d. New Personnel initiatives—training programs with dedicated funding for all levels of students, post-doctoral work
- e. Create incentive structure for laboratories to pilot programs for increasing research productivity
- f. Pilot funding mechanisms (or test increasing existing programs) that provide short- to medium-time period funding for immediate needs to university research
- g. Harmonize regulatory standards for all laboratory sectors

Appendix C.

Governance Annotated Bibliography

Bozeman, C. 1990. "The Environments of U.S. R&D Laboratories: Political and Market Influences." *Policy Sciences* 23(1): 25–56.
<http://www.springerlink.com/content/m31q7302544601u0/>.

Bozeman's article discusses the change in laboratory R&D strategies from a decentralized effort to more organized cooperative approaches, especially at government laboratories. Beginning with the industrial laboratories from the mid-1920s, Bozeman outlines the formation of the U.S. laboratory system and the global and market pressures that led to the technology-development mechanisms present in the early 1990s. The paper characterizes public-policy responses to flaws in the U.S. R&D laboratory enterprise in three general categories: (1) centralization of R&D planning and policy, (2) development of problem-oriented cooperative research center, and (3) refocusing of government laboratories toward market-oriented research and technology transfer. Bozeman finds that industrial laboratories are the most pervasive in the U.S. laboratory system at the time and that this prevalence could be linked to the success of managing behavior associated with commercial enterprises. The study, based on survey data from 966 U.S. R&D laboratories, was used to create an extensive taxonomy of organizational variation within the laboratory structure.

Themes: Historical perspective, trends affecting science and technology

Chait, R. 2009. "Perspectives from Former Executives of the DOD Corporate Research Laboratories." Center for Technology and National Security Policy, National Defense University. <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA496468>.

This paper explores the role of military service laboratories in the national S&T enterprise through a series of interviews with individuals having experience leading research activities at Army, Navy, and Air Force corporate research laboratories. Chait discusses lessons and experience brought forth in interviews with John Lyons (Army Research Laboratory), Timothy Coffey (Navy Research Laboratory), and Vincent Russo (Air Force Research Laboratory), among others. Themes explored by the interviewees revolved around ensuring that the laboratories recruit, train, and maintain high-caliber personnel; the research environment and incentives necessary to maintain high-caliber personnel; choices in performance metrics (e.g. patents, publications); the role of DOD laboratories as a trusted broker in the acquisitions process; and the interfacing of laboratory management with Departmental leadership and Congress. The interviewees provided differing

accounts and opinions on the role of outsourcing aspects of research and administration.

Theme: Trends affecting science and technology, governance structures

Defense Science Board. 2012. "Report of the Defense Science Board Task Force on Basic Research." <http://www.acq.osd.mil/dsb/reports/BasicResearch.pdf>.

This recent Defense Science Board report focuses on assessing the DOD's long-term basic-research portfolio and recommends strategies for increasing and maintaining researcher capabilities; increasing awareness of global research trends; and concentrating efforts to incentivize invention, innovation, and technology transfer. The report states that DOD service laboratories fulfill a unique role in funding basic researchers who are also familiar with military knowledge and may be in a better position to facilitate technology transfer since facilities are co-located with applied and advanced research. To facilitate more engagement, it recommended continuing and expanding support for programs that provide basic science researchers tangible knowledge of S&T challenges faced by the services. Enhancing the linkages between the educational-based enterprises (e.g. universities, S&T programs in high schools) and the DOD S&T enterprise was a common theme. The report includes recommendations for reducing the bureaucratic burden on researchers and for increasing coordination among laboratories (summary on page 88). A major concluding recommendation is for Assistant Secretary of Defense for Research and Engineering to develop a "genuine technology strategy" that provides a guiding vision and objective goals as a component the strategic planning process.

Theme: Trends affecting science and technology, preparing for the future

Hruby, J., Dawn K. Manley, Ronald E. Stoltz, Erik K. Webb, and Joan B. Woodward 2011. "The Evolution of Federally Funded Research & Development Centers." <http://www.fas.org/pubs/pir/2011spring/FFRDCs.pdf>.

This article explores the long history of FFRDCs and how their intrinsic qualities have evolved to address 21st century security challenges. The article outlines the creation of institutionalized FFRDCs, beginning with their origins in the 1942 establishment of institutions like JHU-APL. Transitions, such as JHU-APL's change to a UARC, highlight the differences between classifications, such as increased flexibility of mission. The article presents the current Federal Acquisition Regulations for FFRDCs and elaborates on the enduring institutional characteristics of FFRDCs, such as maintaining a strong commitment to a prime sponsor, an anticipatory nature of national S&T needs, and openness to independent evaluation. The article recommends that FFRDCs adapt to current pressures and drivers by diversifying their capabilities, capitalizing on their unique role working at the interface between private and public sectors, and developing mechanisms to form ad hoc collaborations with multiple FFRDCs to address urgent problems.

Themes: Trends affecting science and technology, governance structures, preparing for the future

Jaffe, A. B., and J. Lerner. 2001. "Reinventing Public R&D: Patent Policy and the Commercialization of National Laboratory Technologies." *Rand Journal of Economics* 32(1): 167–198.

http://128.138.136.233/students/envs_5100/JaffeLerner.pdf.

Jaffe analyzes the structure and potential weaknesses of the Federal laboratory research infrastructure in terms of its ability to successfully commercialize nascent technology. He conducts a statistical analysis of DOE FFRDC patenting activity in the 1980s and 1990s and also highlights a case study that compares Lawrence Livermore National Lab and Idaho National Lab through periods of changing funding levels and changing management in this time period. From these case studies, the paper draws three key observations: (1) the DOE laboratories have a long tradition of informal partnerships with industry and spin-off production; (2) the uncertainty with regard to ownership of a laboratory technology is a commercialization barrier; and (3) the reforms of technology-transfer practices have had a profound impact on the practices within the laboratories themselves. The results of the statistical analysis across all DOE FFRDCs indicated that Federal laboratory patenting levels per R&D spending in the study time period were not significantly different than university patenting trends; the increase in patenting levels at the laboratories was not associated with a decrease in patent quality (as was experienced at universities). The analysis found positive impacts associated with patent activity, geographic proximity to major metropolitan areas, and high levels of university partnership. The study did not conclusively find that there was an impact on patenting activity due to contract turnover. The analysis of patent activity associated with Federal laboratories was more positive than earlier assessments of technology transfer at Federal laboratories, which suggests that the policy reforms from the early 1980s had a positive impact on commercialization activity.

Themes: Trends affecting science and technology (Federal laboratory technology transfer and commercialization), governance structures

JASON. 2008. "S&T for National Security." JSR-08-146.

<http://www.fas.org/irp/agency/dod/jason/sandt-full.pdf>.

The JASON 2008 study on components critical to basic research programs (BA1/6.1 programs) within the DOD presents a critique of DDR&E (now Assistant Secretary of Defense, Research and Engineering) organizational, personnel, and programmatic approaches and makes recommendations to improve DDR&E's basic science research infrastructure. The study notes that (1) the DOD is not adhering to its own definition of 6.1 basic research in its funding choices, (2) basic research has not recently supported innovative initiatives, and (3) independent review of the research portfolio is

often not utilized. The report suggests expanding DOD research laboratories to include more researchers dedicated to basic research in line with broader scientific efforts. Problems associated with recruiting and retaining personnel are attributed to management structure and uncompetitive salaries. Recommended personnel approaches include research leaves from other sectors and incentives like loan-repayment programs. The report also recommends that DDR&E focus on funding basic-science researchers, rather than on funding projects. In addition, the committee recommended that each service maintain a research corps to incorporate military personnel in the DOD S&T enterprise to foster a more dynamic and diverse research pool with incentives aligned with research goals.

Theme: Trends affecting science and technology, preparing for the future (DOD's basic science research portfolio of the past and design for the future)

Hughes, M. E., et al. 2011. "Technology Transfer and Commercialization Landscape of the Federal Laboratories." IDA Paper NS P-4728. Washington, DC: Science and Technology Policy Institute. <https://www.ida.org/upload/stpi/pdfs/p-4728nsfinal508compliantfedlabttcreport.pdf>.

The Department of Commerce, Economic Development Administration, in conjunction with the National Institute of Standards and Technology, asked the IDA Science and Technology Policy Institute to study the landscape of technology transfer and commercialization at the Federal laboratories to establish a baseline for further action. Based on interviews with technology-transfer personnel in agencies and laboratories nine mutually influential factors that were identified appear to affect the speed and extent of dissemination of technologies transferred from Federal laboratories to the private sector. One critical factor is laboratory management. Differences between GOGO and GOCO laboratories can affect technology transfer and commercialization activities. GOCO laboratory leadership is often explicitly tasked to perform technology transfer and commercialization, while GOGO laboratories must comply with certain government regulations that do not affect GOCOs.

Theme: Governance structures (advantages and disadvantages of governance structures)

National Academy of Sciences. 2012. "Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories." http://www.nap.edu/catalog.php?record_id=13367.

As mandated by Congress in the 2010 Defense Authorization Act, this National Research Council study looks at the quality and management of science and engineering at NNSA laboratories—LANL, Sandia, and LLNL. This analysis contains findings relating to the contracting structure within the NNSA laboratories, an analysis of the research base and evolution of the laboratory missions, current management practices dictating the tasking of

the laboratories, and the individual S&E management constructs for each site. NRC authors interviewed congressional staffers, NNSA and DOE leadership, NNSA site office staff, and current and former researchers. The re-compete of contracts of LLNL and LANL was a significant focal point of the study. Staff-level input suggested that the re-compete had negative effects on science and engineering capabilities and morale despite continued focus on mission work. Major recommendations include recognizing that NNSA laboratories primarily support the maintenance of the national stockpile as a core mission while acknowledging that continued support for laboratory directed research is a key component of maintaining and training personnel. Other recommendations include redeveloping the managerial and governance relationship to achieve higher trust levels between research program execution and laboratory operations, reducing administrative burdens on directors to focus on science-and-engineering-related tasks, and working with headquarters' leadership to implement cost savings by recognizing security and safety achievements.

Themes: Governance structures, preparing for the future

Naval Research Advisory Committee. 2002. "Science and Technology Community in Crisis." <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA423395>.

In a report requested by the Director of Defense Research and Engineering, a panel comprised of members from the Naval Research Advisory Committee (NRAC), Army Science Board, and Air Force Scientific Advisory Board convened to address concerns regarding the recruitment and retention of scientists and engineers within the DOD laboratories. The panel based their conclusions on a review of past studies. Recommendations were made to obtain commitment to the importance and value of the laboratories, establish a separate personnel system for scientists and engineers, and to seek legislation that would enable laboratories to try alternative governance structures.

Themes: Governance structures, preparing for the future

Naval Research Advisory Committee. 2010. "Status and Future of the Naval R&D Establishment." http://www.nrac.navy.mil/docs/2010_Summer_Study_Report.pdf.

This study focused on the policy and organizational context of the Naval R&D establishment and was conducted in a programmatic context that concurrently mandated an increase in the size of the acquisition workforce and a decrease in the budget. The study was conducted by experts in the NRAC membership along with a number of consultants. Based upon the results of the study, the NRAC panel recommended a list of actions for the Chief of Naval Operations, Assistant Secretary of the Navy (Manpower and Reserve Affairs), Assistant Secretary of the Navy (Installations and Environment), Assistant Secretary of the Navy (Research, Development and Acquisition), and Chief of Naval Research to rebuild and modernize the

Naval R&D establishment. Among several take-away conclusions, the report stated that the Department of the Navy has a weakened technical workforce and should take actions to rebuild this expertise and improve coordination between related communities.

Theme: Preparing for the future

Office of Technology Assessment. 1995. *A History of the Department of Defense Federally Funded Research and Development Centers*. Washington, DC: U.S. Government Printing Office.

<http://www.princeton.edu/~ota/disk1/1995/9501/9501.PDF>.

This report provides a detailed history of the establishment, changing roles, and evolution of FFRDCs from their founding through 1995. The account includes the rationale for creating the early Federal research centers as well as Federal Acquisition Regulations that govern each FFRDC. From the perspective of 1995, the report documents the classifications of FFRDC governance structures at the time, along with profiles of current FFRDCs and their associated budget trends. The study reviews the impetus for establishing each FFRDC; founding principles surrounding each FFRDC as independent, but long-term, partners with sponsor agencies; and the evolution of these relationships. In addition, the Office of Technology Assessment documents FFRDC criticism by Congress and other weaknesses inherent with the system. By outlining the changes in financial ceilings and regulations, the report illustrates how FFRDCs have transitioned into their present form.

Themes: Trends affecting science and technology (historical evolution of FFRDCs), governance structures

Appendix D.

Literature Recommendations Meta-Analysis

Table D-1 provides the findings, presented by theme and source, of a meta-analysis of recommendations from reports on Federal laboratories from the past two decades.

Table D-1. Synthesis of Recommendations Reports on Federal Laboratories, 1990–2002

	Decker et al. (2012)	DSB (2012)	NRC (2012)	Kavetsky, Marshall, and Anand (2010)	NRAC (2010)	DeYoung (2009)	Perry and Schlesinger (2009)	Townsend, Kerrick, and Turpen (2009)	GAO (2008)	JASON (2008)	NRC (2004)	NRAC (2002)	DOD (1996)	DSB (1994)	NAS (1994)	NTIS (1991)
Mission Clarity and Research Strategy																
Increase local controls over research budgets (LDRD/Section 219)	X	X	X	X	—	X	—	—	—	—	—	—	—	—	—	—
Reduce funding categories/other funding reform issues	—	—	X	—	—	—	—	X	—	—	—	—	—	—	—	—
Consolidation or reorganization of laboratories	X	—	—	—	—	—	—	—	—	—	X	—	X	X	X	X
Reduce duplicative efforts	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—
Better define research mission/strategy	X	X	X	—	—	—	—	—	—	—	—	—	X	—	—	—
More money to universities and FFRDCs/ more outsourcing	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—

	Decker et al.(2012)	DSB (2012)	NRC (2012)	Kavetsky, Marshall, and Anand (2010)	NRAC (2010)	DeYoung (2009)	Perry and Schlesinger (2009)	Townsend, Kerrick, and Turpen (2009)	GAO (2008)	JASON (2008)	NRC (2004)	NRAC (2002)	DOD (1996)	DSB (1994)	NAS (1994)	NTIS (1991)
Personnel Issues																
Increase hiring flexibility/ease hiring restraints/ maintain personnel demonstration programs	X	X	—	X	X	X	—	—	—	—	—	X	—	—	X	X
Identify role of military scientists/increase awareness between military programs and science and technology	X	X	—	X	X	X	—	—	—	X	—	X	—	—	—	—
Increase post-doc investment (including internships and other student outreach/ involvement)	X	X	—	—	—	—	—	—	—	X	—	—	—	—	X	—
Regulatory																
Reduce regulatory burden	X	—	X	—	—	—	—	—	—	—	—	—	—	—	X	—
Agency Oversight																
Clarify role of OSD (control and oversight)	—	X	—	—	X	—	—	—	—	X	—	—	—	X	—	X
Increase rotations/improve relationship/clarify boundaries between laboratory leadership and sponsors	—	X	X	—	—	X	—	—	—	X	—	—	—	—	—	X
Improve corporate memory/share best practices at oversight agency	—	X	—	X	—	—	—	—	X	—	—	—	—	—	—	—
Establish advisory committees	—	X	—	X	—	—	—	—	—	X	—	—	—	—	—	X
Collaborations																
Increase general collaborations	—	X	—	X	X	—	—	—	—	X	—	—	—	—	X	—
Increase rotation of scientists & engineers between Federal laboratories and industry/academia	—	X	—	—	—	—	—	—	—	X	—	—	—	—	—	—
Increase international collaborations	—	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—
Facilities and Infrastructure																
Provide more funding for facilities and infrastructure/change planning processes	X	—	—	X	X	X	X	—	—	—	—	—	X	X	—	—

Appendix E. Panelists

Table E-1. Names and Affiliations of Panelists

Name	Affiliation	Date (2012)
Carol Adkins	Sandia National Laboratories	24 May†
Parney Albright	Lawrence Livermore National Laboratory	15 May
Kathi Alexander	Department of Energy	25 May*
Steve Ashby	Pacific Northwest National Laboratory	24 May†
Kelly Beierschmitt	Oak Ridge National Laboratory	24 May†
Arden Bement	Purdue University	3 May
Linton Brooks	Department of Energy, National Nuclear Security Administration (former)	20 Apr
Claude Canizares	Massachusetts Institute of Technology	3 May
Steve Cary	U.S. Army Corps of Engineers	15 May
Uma Chowdhry	DuPont (former)	3 May
Dana Christensen	National Renewable Energy Laboratory	24 May†
Tim Coffey	Naval Research Laboratory (former)	23 Apr
Phil Coyle	Office of Science and Technology Policy (former)	20 Apr
Madelyn Creedon	Department of Defense, Assistant Secretary for Global Strategic Affairs	23 Apr
James Decker	Department of Energy, Office of Science (former)	20 Apr
Don DePaolo	Lawrence Berkeley National Laboratory	24 May†
Don deYoung	Naval Research Laboratory	25 May*
Matt Evans	Lockheed Martin	23 Apr
John Fischer	Department of Defense, Assistant Secretary for Research and Engineering	30 May*
Patrick Fitch	National Biodefense Analysis and Countermeasures Center	15 May
Doon Gibbs	Brookhaven National Laboratory	24 May†
Bart Gordon	K&L Gates	23 Apr
David Hill	Idaho National Laboratory	24 May†
Keith Hodgson	Stanford Linear Accelerator Center, National Accelerator Laboratory	24 May†
Paul Hommert	Sandia National Laboratories	15 May
Ken Jackson	Lawrence Livermore National Laboratory	24 May†
Alfred Johnson	National Institutes of Health	15 May
Robert Kavetsky	Office of Naval Research (former)	4 Jun*
Richard Keegan	National Aeronautics and Space Administration	15 May
Young-Kee Kim	Fermi National Accelerator Laboratory	24 May†
Michael Kluse	Pacific Northwest National Laboratory	15 May
Jerry Krill	Johns Hopkins University Applied Physics Laboratory	15 May
Steven E. Koonin	Institute for Defense Analyses and New York University	20 Apr, 3 and 15 May
Mary Lacey	Department of Defense-Navy, Deputy Assistant Secretary of the Navy for	20 Apr

Name	Affiliation	Date (2012)
	Research, Development Test and Evaluation	
Skip Lackie	Office of Naval Research (former)	4 Jun*
John Marra	Savannah River National Laboratory	24 May†
Michael Marshall	Office of Naval Research (former)	4 June*
Thom Mason	Oak Ridge National Laboratory	15 May
Duncan McBranch	Los Alamos National Laboratory	24 May†
Bob McKeown	Thomas Jefferson National Accelerator Facility	24 May†
Charles McMillan	Los Alamos National Laboratory	15 May
George Miller	Lawrence Livermore National Laboratory (former)	20 Apr
John Miller	Army Research Laboratory	15 May
Michael Nacht	University of California, Berkeley	3 May
Venkatesh Narayanamurti	Harvard University	20 Apr
Adam Nave	Department of Defense-Navy. Office of the Deputy Assistant of the Navy for Research, Development, Test and Evaluation	20 Apr
G. Hutch Neilson	Princeton Plasma Physics Laboratory	24 May†
Paul Nielsen	CMU Software Engineering Institute	3 May
Tara O'Toole	Department of Homeland Security	23 Apr
Greg Poe	Logos Technologies, Inc.	26 Jun*
Tyler Przybylek	Universities Research Association	23 Apr
Dan Reed	Microsoft Research	3 May
Victor Reis	Department of Energy	21 May*
Maxine Savitz	National Academy of Engineering	3 May
Joseph Sciabica	Air Force Research Laboratory	29 May*
Charles Shank	Howard Hughes Medical Institute	20 Apr
George Singley	Department of Defense, Deputy Director of Research and Engineering (former)	30 May*
Robin Staffin	Department of Defense, Assistant Director for Research and Engineering	3 May
Devon Streit	Department of Energy	24 May†
Michael Telson	General Atomics Corporation	20 Apr
Tony Tether	Department of Defense, Defense Advanced Research Projects Agency (former)	20 Apr
Jeff Wadsworth	Battelle	3 May
Steven Walker	U.S. Air Force	3 May
David Whelan	The Boeing Company	20 Apr

* Individual interviews.

† Discussions at Department of Energy Chief Research Officer Meeting.

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Abbreviations

AFRL	Air Force Research Laboratory
AMRIID	Army Medical Research Institute for Infectious Diseases
ARL	Army Research Laboratory
BRAC	Defense Base Closure and Realignment Commission
COCO	Contractor-Owned, Contractor-Operated
CRS	Congressional Research Service
DDR&E	Director of Defense Research and Engineering
DHS	Department of Homeland Security
DOD	Department of Defense
DOE	Department of Energy
DSB	Defense Science Board
FFRDC	Federally Funded Research and Development Center
FTE	full-time equivalent
FY	fiscal year
GAO	Government Accountability Office
GOCO	Government-Owned, Contractor-Operated
GOGO	Government-Owned, Government-Operated
IDA	Institute for Defense Analyses
JHU-APL	Johns Hopkins University Applied Physics Laboratory
LANL	Los Alamos National Laboratory
LDRD	Laboratory Directed Research and Development
LLNL	Lawrence Livermore National Laboratory
M&O	management and operating
MILCON	military construction
MIT-LL	Massachusetts Institute of Technology Lincoln Laboratory
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NBACC	National Biodefense Analysis and Countermeasure Center
NNSA	National Nuclear Security Agency
NRAC	Naval Research Advisory Committee
NRC	National Research Council
NRL	Naval Research Laboratory
NSF	National Science Foundation
NTIS	National Technical Information Service
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
R&D	research and development
S&AC	Studies and Analysis Center
S&T	science and technology
SEIC	Systems Engineering and Integration Center

STPI	Science and Technology Policy Institute
STRL	Science and Technology Reinvention Laboratories
UARC	University Affiliated Research Center
WFO	Work for Others

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14. ABSTRACT Academic institutions, industrial organizations, and Federal laboratories make up the system of research organizations that support science and technology for U.S. national security. For the approximately 80 Federal laboratories with a national security focus, missions, research portfolios, budgets, and governance structures vary significantly. STPI convened a series of expert-panel discussions aimed at studying the sufficiency of the Federal laboratory system's governance structures to meet future national security needs. The panel discussions focused on trends affecting Federal laboratories with national security missions, the advantages and disadvantages of the various Federal laboratory governance structures, and how best to prepare for the United States' future national security needs. The panels consisted of former and current laboratory directors, agency-level personnel, and laboratory leaders from academia and industry. This report presents expert recommendations from the panel discussions and literature review for ensuring the national security Federal laboratory system is capable of addressing current and future challenges.						
15. SUBJECT TERMS Department of Defense (DOD), Department of Energy (DOE), Department of Homeland Security (DHS), Federally Funded Research and Development Centers (FFRDC), Federal Laboratories, Governance, Government-Owned/Government-Operated (GOGO), National Security, University Applied Research Centers (UARC)						
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